A DISCUSSION OF THE NINE M'S OF SCIENTIFIC MANAGEMENT

A THESIS

SUBMITTED TO THE FACULTY OF ATLANTA UNIVERSITY IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF BUSINESS ADMINISTRATION

BY

KENNETH HAROLD BRIGGS

SCHOOL OF BUSINESS ADMINISTRATION

ATLANTA, GEORGIA

AUGUST 1964

ACKNOWLEDGEMENTS

Special appreciation is due to my wife, Patricia Henderson Briggs, for her help in typing and editing the drafts and preliminaries of this thesis. Also, for her encouragement, patience, and understanding throughout the months spent on research and writing.

The author is deeply indebted to Dr. K. K. Das, Professor of Management, Atlanta University, and Dr. Harding B. Young, Dean of the School of Business Administration, Atlanta University, for their guidance and timely suggestions, which did much to make this thesis a success.

Kenneth H. Briggs

Atlanta, Georgia
August, 1964

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

Purpose of Thesis.--This thesis has been written in order to present and discuss the nine M's of scientific management: Methods, Money, Men, Materials, Machinery, Maintenance, Manufacturing, Marketing, and Measurement. It endeavors to give the procedures which modern industrial and business managers are actually using in the management of their companies. It is scarcely necessary to mention that this thesis can hope to do little more than arouse an interest in the subject of scientific management and point the way to the detailed books where such an interest can be more deeply aroused and more fully satisfied. The footnotes have been prepared with great care. By reading the references there given, one can verify statements in the text, and also, if he desires, inform inform himself at length on any branch or aspect of the subject that especially interests him.

In discussing the nine M's of scientific management, the author will point to the fact that:

1. Contrary to the widespread belief that scientific management kills individuality, it is built on the basic principle of recognition of the individual, not only as an economic unit but also as a personality, with all the idiosyncrasies that distinguish a person.
2. Through the practice of scientific management the management is unified and made constant.
3. The method of teaching of scientific management is

a distinct and valuable contribution to business education.
4. There is no contradiction between the worker's welfare and scientific management.
5. Scientific management is applicable to all fields of activity, and to mental as well as physical work.
6. Scientific management is applicable to self-management as well as to managing others.
7. Because scientific management is psychologically right it is the ultimate form of management.

Definition and Scope of Scientific Management.--The roots of scientific management are to be found in the life and thought of the late Dr. Frederick W. Taylor.[1] Taylor is regarded in the United States as the "father of scientific management."[2] Scientific management attempts to apply the logic of effective thinking to the solution of business problems. It uses the applied business knowledge and principles that have been accumulated, classified, codified, and accepted to date, with due allowance for their limitations.

In the first place, scientific management may be set down as confined to that one side of human life wherein men cooperate to attain industrial ends. The goal is usually material wealth; the actors must include a leader and a team of followers; the typical habitat of the system is, in short, the shop, the office, or the gang of laborers.

Secondly, the horizon of scientific management may be further limited to that one phase of shop or industrial life which

---

[1]For a complete biography of Frederick W. Taylor, see: Frank B. Copley, Frederick W. Taylor, The Father of Scientific Management (New York: Harper and Brothers, 1923), Vols. I and II.

[2]Ralph C. Davis, The Fundamentals of Top Management (New York: Harper and Brothers, 1951), p. 5.

has to do with the control of men. Excluded from scientific management is the financial aspect of business--that is, that which has to do with the relation of a company with its stockholders and the keeping of accounts. Cost accounting, however, is within the scope of scientific management. Dr. Taylor did important and pioneer work in this field, and Henry L. Gantt[1] urged important cost accounting reforms. Even general accounting has been studied to a certain extent. To one side lie problems connected with the technique of production--that is, scientific management does not primarily concern itself with those aspects of chemistry, physics, and mechanical engineering which determine the processes of manufacture. Scientific management must take all these fields into consideration, and often marked improvement is attained in them because of the method of scientific management. The handling of men, however, is the system's first consideration, and its main reason for existence.

Finally, may we venture once again to narrow the scope of our subject, and conclude that scientific management's position is that of but one of the many movements which aim to improve the relations of management and men. Scientific management we regard as an historical entity, something concrete, whose presence can be detected and verified by the observation of distinctive accompanying features.

Origin of the Nine M's.--Taylor believed that there were seven phases of management that need to be selected, controlled, and disposed of scientifically before scientific management

---

[1] See Chapter II for a brief life sketch of Gantt.

could be realized to its full capacity. These seven phases are: Methods, Money, Men, Materials, Manufacturing, Marketing, and Measurement. Thus, excluding Machinery and Maintenance. As time passed, scientific management men and other leading authorities concluded that industry is heavily depended on machines, especially in the manufacturing process. Therefore, Machinery, also, need to be selected and controlled scientifically. Shortly afterwards, Machinery was added to the phases of scientific management. As machinery became worn, damaged or obsolete, the need for upkeep, repair, renewal, and replacement became an all important problem for management. This problem was solved with the introduction of scientific Maintenance.

Since these nine phases of scientific management all begin with the letter "M," it is obvious that modern managers termed them as "The Nine M's of Scientific Management."

Scientific management deals with many and varied problems which run the gamut of the nine M's. The task is large and difficult, but scientific management is expected to do the largest and most difficult of tasks.

About this Thesis.--This thesis could well serve as a scientific business procedure guideline for those wishing to obtain a broad picture of the nine M's of scientific management. Each chapter is divided into subheadings which deals with different facets of the corresponding "M" of scientific management.

Each of the nine M's is discussed in a separate chapter beginning with the third. Chapter II gives a bried account of the lives and works, including certain contributions to the enrichment of scientific management, of the makers of the nine M's.

The last chapter concludes with the future outlook of scientific management.

The philosophy presented in this thesis is the author's. It is, however, representative of the best thought of management authors and business leaders, both past and present. It is hoped that it will be a stimulant to further thinking by all managers and students of management, both academic and executive.

CHAPTER II

THE MAKERS OF THE NINE M'S OF SCIENTIFIC MANAGEMENT

Mr. Taylor early began to gather about himself a group of disciples. These disciples, though inspired in large measure by the vision and courage of their leader, were yet more than mere imitators. Taylor, in spite of his warm championship of practice as over against theory, was himself a man of great ideas. Ideas which were considerably in advance of what had been fully worked out. It was largely as aids in putting these ideas into practice that his followers have made their impress upon scientific management. Not only in the more subtle mathematical laws governing the operation of machines, and in applying new principles to wage systems and management in general, have these associates molded the outer form of, and given fuller content to scientific management.

The first colleague of Taylor was the late Henry L. Gantt,[1] inventor of the bonus system, and during his life generally known as the surest result-getter of the men who were introducing scientific management. Twelve years later, but still among the earlier men, came Carl G. Barth, mathematician, and inventor of the Barth

---

[1]L. P. Alford, Henry Laurence Gantt, Leader in Industry (New York: Harper and Brothers, 1934).

slide rule. With these may be associated Horace K. Hathaway, well known for his skill in perfecting scientific management for the Tabor Manufacturing Company of Philadelphia, and the eminent and versatile Morris L. Cooke, for a number of years Director of Public Works at Philadelphia. Sanford E. Thompson performed pioneer work in extending the principles of scientific management from the machine shop into the building trades, while Frank B. Gilbreth[1] won great admiration by his display of genius in the reorganization of bricklaying. Finally may be mentioned Harrington Emerson who, in addition to his commercial activities, has had much to do with making "efficiency" an every-day word.

Frederick W. Taylor.--The work of Frederick W. Taylor gave the greatest and just impetus to scientific management. While preparing for Harvard at the Phillips Exeter Academy his eyesight became impaired. This difficulty caused him to leave school and enter the employ of the Midvale Steel Company in Philadelphia in 1878. He was successively and successfully gang boss, assistant foreman, foreman of the machine shop, master mechanic, chief draftsman, and chief engineer, to 1889. While working at the Midvale Steel Company he carried on his engineering education at the Stevens Institute of Technology without attending classes. Although the effort of combining his technical studies with employment was strenuous, he graduated in 1883. After he left the Midvale Steel Company he began the work of

---

[1]Lillian M. Gilbreth, The Quest of the One Best Way--A Sketch of the Life of Frank Bunker Gilbreth (New York: The Society of Industrial Engineers, 1923).

organizing the management of manufacturing establishments of various kinds, which included the Bethlehem Steel Company and the Williams Cramp and Sons Ship and Engine Building Company of Philadelphia.

Mr. Taylor took out about one hundred patents. His greatest invention was the discovery between 1898 and 1900, of the process of treating tungsten steel. This invention, according to the highest authorities, has revolutionized the machine shops of the world, enabling tools to cut metal at least three times as rapidly as before. The inventor received $100,000 for the English patents alone. Fame again came to Mr. Taylor upon his publication, in 1906, of the results of the extended researches of himself and others in the art of cutting metals[1]--a work of genuine scientific character, and of the highest practical importance. My. Taylor, however, is regarded as of far greater moment than all this other work for his share in the discovery of the principles of scientific management.

By strenuous effort and through many difficulties in engineering and management in steel companies and other manufacturing plants he developed the first principles of scientific management, which he later stated as follows:

> Scientific management in its essence, consists of a certain philosophy, which results in a combination of the four great underlying principles of management:
> First: The development of true science.
> Second: The scientific selection of workmen.
> Third: Their scientific education and development.

---

[1] "On the Art of Cutting Metals," in Transactions of the American Society of Mechanical Engineers, Vol. XXVIII.

Fourth: Intimate, friendly cooperation between the management and the man.[1]

Although Taylor's chief contributions were the principles of scientific management, he made a number of other specific management contributions, such as the Taylor differential piece rate system of wage payment, time study,[2] method study, as well as his procedure for carrying on research.

Among his other writings are: "A Piece-Rate System," 1885; "Shop Management," 1903; and with Sanford E. Thompson, he has written Concrete, Plain and Reinforced (1905), and Concrete Costs (1911). His philosophy is, however, best expressed in The Principles of Scientific Management (1911). His system is also explained in contributions to the periodicals; in numerous addresses; in testimony before the special House committee which investigated scientific management (1911-1912); and in testimony before the Industrial Relations Commission (April, 1914).

After his death, Taylor's work in scientific management was promoted by the Taylor Society,[3] which combined into the present Society for the Advancement of Management. The American Management Association has aided nobly in carrying forward the management movement. Taylor's principles have withstood the test of time as being fundamentally sound, but, with the constant and rapid changes in industry, the Taylor Society considered that a

---

[1] F. W. Taylor, The Principles of Scientific Management (New York: Harper and Brothers, 1911), p. 130.

[2] See Taylor's definition of time study in the section, "Time and Motion Study," in Chapter III, "Methods."

[3] Formally organized December 4, 1911, as the Society to Promote the Science of Management.

restatement of the principles of scientific management would clarify them in the light of recent practice. H. S. Person, then Managing Director of the Taylor Society, restated the principles of scientific management in 1929 to meet these changing conditions, as follows:

> 1. Management Research. Research, investigation, and experiment (with their processes of analysis, measurement, comparison, etc.) constitute the only sound basis for the solution of managerial problems; for determination of purpose, policy, program, project, product, material, machine, tool, type of ability or still, method and other factors, and the coordination of these in purposeful effort.
>
> 2. Management Standards. To make them useful to an enterprise, the results of research, investigation and experiment must be made available to the cooperating group in the form of defined and published standards which serve as common goals, facilities, and methods, and which replace chance and variable factors by constants in terms of which may be made calculations and plans which may be expected to come true.
>
> 3. Management Control. There must be established a systematic procedure, based on the defined standards, for the execution of work; a procedure which directs the researches, establishes and maintains the standards, initiates operations and controls work in process; which facilitates each specialized effort and coordinates all specialized efforts, to the end that the common objective may be achieved with a maximum of human welfare and contentment, and with a minimum of waste of human and material energies.
>
> 4. Cooperation. Durably effective management requires recognition of the natural laws of cooperation; involving the integration of individual interests and desires with desires and of individual capacities with the requirements of group purposes; the substitution of the laws of situations for individual authority, guess, and whim; and the recognition and capitalization of human differences, motives, desires, and capacities in the promotion of a common purpose.[1]

Henry L. Gantt.--Henry L. Gantt, who was five years younger than Taylor, graduated from Johns Hopkins University with the degree of A.B. in 1880; taught in school for the following

---

[1] H. S. Person (Editor), "The Taylor Society," Scientific Management in American Industry (New York: Harper and Brothers, 1929), pp. 10-11.

three years, and, in 1884, secured his M.E. from Stevens Institute of Technology. His first important work was for the Midvale Steel Company, where he remained six years (1887-1893). It was here that he first came in contact with methods of scientific management, being employed for a year and a half under the direction of Mr. Taylor. His task was to find some means by which the laws governing the cutting of metals might be quickly applied to the practical work of the machine shop. The solution then discovered was only moderately satisfactory; but the incident meant much for scientific management, for from 1887 until his death in 1920 Mr. Gantt, with few interruptions, spent all of his time in the service of this system.

Gantt's contact with Taylor was cut short in the eighties, and was only intermittent in the varied work of the next ten years. In was renewed again in the completest manner when in March, 1899, Taylor called Gantt to Bethlehem. In 1899 one of Gantt's undertakings at Bethlehem was the development of a rough type of slide rule. A few months later Carl G. Barth so perfected this device that it could solve with remarkable ease the problem which in the eighties Gantt had by himself only partially mastered. The main credit for the slide rule belongs, accordingly, to Barth; Gantt regarded as his own greatest achievement of this period the development of "Task Work with a Bonus."

The task and bonus system was put into operation at Bethlehem immediately after its suggestion, and worked so well that no changes had been made up to the time when Mr. Gantt left the plant in August, 1901. In the winter and spring of 1902, however, Gantt developed for the American Locomotive Company an amended

bonus system, which was designed for permanent use. It was made to offer not only a reward for the completion of the task in the allotted time, but also an additional inducement to those who were able to do still better. It consisted in giving to all workers their day rate, but to the men who finished their tasks in the time set or less, pay for the number of hours allotted plus a certain percentage of that time.

The bonus system--whether it be of the original type (designed only for temporary use) or of the amended variety (suited to become a part of the permanent system)--is like the differential rate system, in that they both give the man who performs a good day's task a higher rate of pay than is customary in the trade. The original type of bonus differs from the differential rate in that the former involves no creation of alterable piece rates. The amended bonus system is more flexible than the differential rate, in that if it be so desired different men can be allowed varying amounts of pay for the same work--by simply basing their remuneration on higher or lower day rates. Both the new varieties depart from the old path in that they give the regular day's pay to learners and others who fall short of the standard. The task and bonus system was at once recognized as valuable, and at the present time is more commonly used than the differential rate.[1]

We have seen that Gantt's greatest contribution to the method of scientific management was a very mild and easily introduced bonus system. The key to his success was a disposition to

---

[1]Alford, op. cit., p. 30.

adjust his course to the practical aspects of whatever situation confronted him. Mr. Gantt regarded every factory as a law unto itself. His idea of scientific management was not that of one mold, which all factory organizations must be warped to fit; but as he saw it, there were as many distinct scientific managements as there were different shops. By many who ought to know, Gantt was regarded as the strongest man in the scientific management movement.

Gantt's leading works were: "A Bonus System for Rewarding Labor" (1901), "A Graphical Daily Balance in Manufacture" (1903), and Training of Workmen" (1908). These three works are found in the Transactions of the American Society of Mechanical Engineers; his books are Work, Wages and Profits (1910 and new editions), Industrial Leadership (1916), and Organizing for Work (1919); and various periodical contributions.[1]

Carl G. Barth.--Carl G. Barth, mathematician, and inventor of the Barth slide rule, did not come into actual touch with scientific management until 1899. His earlier training was acquired in his native Norway, and consisted of the equivalent of a high school education, followed by a technical course lasting a year and a half; and then four years practical experience, of which the first two were spent as an apprentice in navy-yard boiler and machine shops, and the second two in teaching mathematics and mechanical drawing, interspersed for a time with service in the office of the superintendent of the yards.

---

[1]Horace B. Drury, Scientific Management (New York: Columbia University Press, 1922), p. 125.

As a youth of about twenty-one, Barth emigrated to America, and found employment in the drawing-room of William Sellers and Company, of Philadelphia. With this concern, he remained (excepting a short intermission) for fourteen successive years, at the end of which period he was occupying the position of chief designer. During most of this time Barth had been devoting his odd hours to teaching, for six years meeting mechanical drawing classes at the Franklin Institute on some evenings of the week and private pupils in mathematics on the others and then for two years conducting a private evening school of his own. But now a taste for a career as a professor of engineering was rapidly developing; and in order to equip himself for such a position, Barth first gave up evening work for pay, that he might improve his knowledge of engineering subjects.

Though Barth at this time "paid but little attention to the general management side" of scientific management, he was very much interested in those features of the system with which his work brought him in special contact. Since 1901 he busied himself with introducing scientific management into factories and afterwards broadened out until he understood every side of the system. According to Gantt, he was the most expert of the scientific management men in looking over and strengthening the weak places in machines. According to Taylor,[1] he was the most accomplished of all the men engaged in this work (installing the system as a whole), a man who made a greater success of introducing scientific management into the difficult companies than

---

[1]From correspondence dated October 6, 1913.

any other single man.[1]

Horace K. Hathaway.--While Gantt is praised as a manager, and Barth as a mathematician and master of mechanical equipment, to Horace K. Hathaway belongs, according to Taylor, the credit for being the best all-around man in the movement. He had no degree in engineering, but received his training during two years (1894-1896) spent in a trade school (Williamson), and a year and a half spent as an apprentice with the Midvale Steel Company. He served about six months as a journeyman machinist, and then worked up in the organization through the positions of draftsman, inspector, and gang boss, until he was finally made foreman over all the tool making and tool keeping rooms in the plant.

In was not until 1904 that Hathaway came in contact with scientific management, through being detailed to assist Barth install the system in the Philadelphia plant of the Link-Belt Company. This first assignment was, however, comparatively unimportant. After only two or three months, Hathaway was transferred from the Link-Belt plant, and placed with the Tabor Manufacturing Company, also of Philadelphia, at the time also in charge of Barth. Here, as the years went by, he gave so good account of himself that he eventually became the most important person about the works. As vice-president of the company, Hathaway brought the organization to so high a degree of perfection that the Tabor plant came to be regarded as the finest example of the success of scientific management. Its productivity had been multiplied by three.[2]

---

[1]Drury, op. cit., pp. 126-128.

[2]Ibid., pp. 129-130.

Morris L. Cooke.--The special importance of the work of Morris L. Cooke is derived from the fact that it marks an extension of scientific management into new fields. We will pass over without comment Cooke's life as a mechanical engineer, and even that part of his career which had to do with the introduction of scientific management into printing, in order that we may come at once to the unique lines along which he distinguished himself.

The first of these undertakings grew out of the decision of the Carnegie Foundation for the Advancement of Teaching to get a man familiar with modern business management to estimate the cost and output of leading American universities. The man commissioned to make this study was Cooke; the field selected for investigation comprised the various departments of physics; the institutions visited were Columbia, Harvard, Massachusetts Institute of Technology, Toronto, Wisconsin, Haverford, Princeton, and Williams. Though Cooke's 134-page report, published in 1910, as Bulletin Number Five of the Carnegie Foundation, contains various valuable recommendations in regard to the strictly financial and business relations of the university, these cannot be discussed here. Our one interest at this time is in pointing out certain passages in which Cooke, who is a staunch Taylor man, tries to apply scientific management to the universities' central educational end.

Cooke regards the careful arrangement of the work so that the unusually able and highly valuable men who make up the ranks of professors may specialize in the important fields for which they are peculiarly qualified as the cardinal principle in university administration. Thus, it seems to him a great waste when,

"during the interviews which he had with college professors, he found them spending time in taking inventories, keeping track of appropriations, mimeographing examination papers and handling routine correspondence." He also finds fault with their being given the management of buildings. Cooke maintained that part of this work could be delegated to clerks, and much of it could be done more efficiently by central administrative departments, that would look after special functions for the university as a whole.

A second opportunity to extend scientific management into new fields occurred when Mr. Cooke was made director of public works for Philadelphia. The magnitude of the engineering and business problems involved in the running of a great city is appreciated when it is noted that Mr. Cooke and his department were responsible for annual expenditures amounting to about $11,000,000.

The result of the four years of this administration was to introduce into the Philadelphia government a spirit which, at least in its larger outlines, may be said to have been in harmony with that of scientific management. In the actual application of principles, however, the chief emphasis was upon policies and details which are somewhat different from those called for in factories, but which in the Philadelphia situation became the significant issues. The keynote of the administration, Mr. Cooke says, was the employment of experts. During four years there were almost a hundred such, operating in different fields, and outside the routine organization of the department. A number of these experts were professors in the University of Pennsylvania.

After the death of Dr. Taylor, Mr. Cooke in fact held first place as the public man of the scientific management movement. He was a leader, both in organizing and strengthening the movement from within, and in introducing and interpreting the system to the public. Of recent years he has given special thought to two phases of management, first that of the human relations, and second that of the symbolizing and indexing of functions.[1] His work in both of these fields, though that of the pioneer, is rich in promise, and merits specialized attention and study that unfortunately cannot be given in this thesis.

Sanford E. Thompson.--Sanford E. Thompson, referred to by Taylor[2] as "perhaps the most experienced man in motion and time study in this country," was born in 1867, took the degree of S.B. in 1889, and since 1888 was engaged in practical civil and mechanical engineering. In 1895 he started to cooperate with Taylor in some of the latter's investigations, and in 1896 and the years following undertook in collaboration with Taylor an exhaustive study of the time required to do various work connected with the building trades. In six years he made a careful study of eight of the most important of them: excavation, masonry, bricklaying (including sewer work and paving), carpentry, concrete and cement work, lathing and plastering, slating and roofing, and rock quarrying.[3]

---

[1] Ibid., pp. 131-136.

[2] Taylor, op. cit., p. 88.

[3] Jointly with Taylor, Thompson has written: Concrete, Plain and Reinforced (1905 and later editions), and Concrete Costs (1911).

Thompson's method was to split up jobs as a whole into separate operations, finding the time in hundredths of a minute for performing each operation. By stop-watch analysis, for example, he determined the unit times for such operations as throwing a single shovelful of earth, filling a wheel barrow, walking one foot, driving one nail, placing one cleat, and doing a thousand other things. He then used mathematical formulas to combine the units on each particular job. As a result, a contractor could estimate much more exactly than under the old system how much it would cost to complete a given work, and a foreman could gain an idea of the rate at which the men were working.[1] Thompson is credited by Taylor with having developed in the course of his studies implements for taking observations which were in many respects the best in use.[2]

Frank B. Gilbreth.--No description of the management movement and its development would be complete without a statement of the work and contributions to the field of management of Frank B. Gilbreth.

While preparing for college at the Boston schools he felt the urge of a business career upon being encouraged by a friend to enter the contracting business. After serving as an apprentice, he rose rapidly through supervisorship to be a manager. The next step was either to form a partnership or to enter business for himself. He chose the latter. In his own company he soon built

---

[1]Sanford E. Thompson, "Time-Study and Task Work," in Journal of Political Economy, May, 1913, p. 380.

[2]Drury, op. cit., pp. 136-138.

a reputation for doing things which other contractors could not do, such as waterproofing cellars, speed work, operate on cost plus a fixed sum, and various other concrete and business systems. He applied time, motion, and fatigue study to work and prepared standard practice instructions, all of which led him to enter the management field, where he established management methods not only in construction companies, but also in various types of industrial plants. He also applied these methods to the production of supplies during World War I. After the Armistice he continued his work and established laboratories for research in management methods.

His contributions to the scientific management movement were great. Among the most important were:

1. Motion Study: (a) The reduction of best practice to writing and the enumeration of the motions used and the variables which affect each motion, therbligs,[1] and cyclegraphs; and (b) the one best way of doing work.[2]
2. Fatigue Study: The accurate determination of the causes of fatigue in performing various types of work, the elimination of all unnecessary fatigue, the reduction of the necessary fatigue to the lowest amount possible, the providing of all possible means of overcoming fatigue, and the recording of fatigue facts in such form that every worker can use them for himself to get more out of life.[3]
3. Micromotion Study: The use of motion pictures in motion study.
4. The application of scientific management to industrial work, especially within the fields of motion study, waste elimination, handling of materials, and management

---

[1]"Therblig" is Gilbreth spelled backwards with a slight variation. It was devised by Mr. Gilbreth because no adequate word was available.

[2]Frank B. Gilbreth, Motion Study (London: Constable and Company, 1911).

[3]Frank B. and Lillian M. Gilbreth, Fatigue Study (New York: The Macmillan Company, 1919), p. 7.

conditions; and the emphasis upon the human problems of management, such as, the Three Position Plan of Promotion.[1]

In the development of his later thought, as well as in the writing of many of his papers, Mr. Gilbreth was aided by his wife, Lillian Moller Gilbreth. Mrs. Gilbreth was largely responsible for the deepening of her husband's interests in what they term the psychology of management.[2]

Among Gilbreth's other works are his Field System (1908), Concrete System (1908), Bricklaying System (1909), Primer to Scientific Management (1912), Applied Motion Study (1917), and numerous papers read before engineering and other societies.[3]

Harrington Emerson.--In the case of the men whom we have thus far considered, the main impulse along the path of scientific management came without question directly from Frederick W. Taylor. When, however, we come to the career of Harrington Emerson, we pass from the immediate Taylor group, and find ourselves in the presence of a man who has been under complex influences.

Emerson's earlier efforts in the field of systematizing management were in universities, of which for six years he was registrar, secretary of the faculty, and head of a department. It was not until some years after this that he entered

---

[1]Frank B. and Lillian M. Gilbreth, "The Three Position Plan of Promotion," Annuals of the American Academy of Political and Social Science, May, 1916.

[2]Lillian M. Gilbreth, The Psychology of Management (New York: The Macmillan Company, 1921).

[3]Drury, op. cit., pp. 138-144.

the profession of reorganizing industrial plants. He tells us that in 1895 he began a rapid survey of these, determining what their product and cost were compared to what they ought to be. In 1900, he checked up minutely the losses occurring in the use of materials, while planning, scheduling, and dispatching work through a large factory.

Harrington Emerson was nearly three years older than Taylor. He did not meet the latter until December, 1910, and the two never worked together. As regards to his general thought, Emerson received stimuli from many sources; but as concerns the application of efficiency to industrial plants, there is good ground for believing that he is much more deeply indebted to Taylor than to any other. Men well acquainted with both have said that Emerson was once accustomed to refer to Taylor as the source of his ideas. Taylor, he regarded as trying to do too much, as being in advance of his time; it was he, Emerson, who, by rendering lofty projects more practical, was able to achieve results. On the other hand, it cannot be denied that Emerson brought into the field of scientific management a great deal of his own original thinking. He may have adopted some of Taylor's ideas; but if so, his conduct is similar to the appropriation which every man makes of any scheme that appeals to him as useful; and beyond this, he has at the same time combined them with so many ideas derived from other sources that his resulting philosophical system is a truly original contribution to the subject. Certainly in his books he has expressed himself in a way which is in many respects far more effective than the style of the other scientific management or efficiency men.

In fact, Emerson has done more than any other single man to popularize the subject of scientific management. His books, Efficiency (a reprint in 1911 of periodical contributions of 1908 and 1909), and The Twelve Principles of Efficiency (1912), taken with his magazine articles and addresses, have perhaps done more than anything else to make "efficiency" a household word.[1]

All these--Taylor, Gantt, Barth, Hathaway, Cooke, Thompson, the Gilbreths, and Emerson--have carried forward the scientific management movement until today a company which does not apply science and the scientific method to its work may soon be left behind and will not be able to keep up with modern progress.[2]

---

[1] Ibid., pp. 144-149.

[2] J. E. Walters, Modern Management (New York: John Wiley and Sons, Inc., 1937), p. 12.

CHAPTER III

METHODS

Policies and Principles.--Before a company can begin to act or produce, it must have a policy on which to base the action. A policy represents the central aim or guiding purpose of the organization. It is the idea by which the concern functions. It is the steering principle which focuses the company's activities upon a definite end.

In order to incorporate, a company must state its policy in its articles of incorporation. The reading of the object clause of a corporation's charter should disclose its fundamental policy. Examples of company policies are: "to supply gas heat for every heating purpose"--the People's Gas Light and Coke Company; and "to supply gas, electricity, and transportation to all of the State of New Jersey"--the Public Service Corporation of New Jersey.

Although these statements of policy may be definite, there appears to be a tendency in recent years to make the policies, or rather the object clauses of corporations, as broad as possible to allow for future changes.

Besides the underlying policy which guides the corporation activities, there are always general and specific policies, as well as external and internal policies, which are necessary for realizing the main objective. A company may be chartered

to supply gas, electricity, or transportation to a certain locality, but there is a need for a general policy to indicate how it is to be supplied. Two companies may have the same purpose of producing the same product, yet one may have a policy of producing the best product with regard for price, and the other, a policy of producing a good product at the lowest possible price. One company may be successful, while the other on may fail. A third company, chartered to manufacture the same product, may have a policy of manufacturing the best product at a fair price and accomplish more than the other two. From this, we can see that the company policy may be complex, yet very important.[1]

We have often heard that if a policy cannot be written or stated, it is not definitely known or understood. One of the first qualifications of a good policy is that it be precisely and clearly stated and understood. The statement of a policy does not mean that it cannot be flexible and possible of amendment to meet economic changes, expansion, changes in material, changes in type and nature of production, changes in methods of distribution, business cycles, and other fortuitous circumstances. A constant or periodic reconsideration of policies is essential.

The American Rolling Mill Company of Middleton, Ohio considers the following policies[2] necessary to a comprehensive management program:

---

[1] Ibid., pp. 43-44.

[2] C. H. Murray, "What Personnel Policies Are Included in A Comprehensive Industrial Relations Program?" Personnel (New York: American Management Association, Vol 12, No. 2, 1935), pp. 173-174.

First: To do business guided and governed by the highest standards of conduct and ethics, striving always for that sort of ending in all things affecting the conduct of the business as would make "reputation" an invaluable and permanent asset.

Second: To adopt "Quality and Service" as a slogan. Quality, the highest attainable, to be represented in Product, in Organization, Plant, Property, and Equipment. Service, the best possible, to be rendered to Customers, to Stockholders, to City, State, and Nation.

Third: To make every possible effort to develop and maintain an efficient, loyal, aggressive organization, who believe in their company, to whom work is a pleasure, and extraordinary accomplishment a personal ambition.

Fourth: To provide the best equipment and facilities obtainable, suitable to the particular needs of the business, both from the standpoint of economy in maintenance and operation and that of giving the company's organization the best possible tools with which to work.

Fifth: Never to be satisfied with anything less than the best results possible of attainment in each and every problem to be solved.

Sixth: To be consistent and persistent in the application of Armco (The American Rolling Mill Company) Policies to each and every situation.

In dealing with an individual or a group, always to give the situation or problem in hand every possible consideration after securing all attainable facts.

Seventh: In all decisions affecting the conduct of business, to consider always what is right and best for the business as a whole, rather than what may be expedient in dealing with a single situation.

With policies established and clearly stated, one of the first steps in scientific management is that of organization to carry out the ultimate policy decided upon. This is accomplished by means of general organization and time and motion study.[1]

Organization.--Organization is the division of work into its proper functions, jobs, and elements; their arrangement into correct relationships; and the assignment of them to individuals with clear definitions of responsibility, authority, and duties which will accomplish the policies of the establishment.

---

[1]Walters, op. cit., p. 46.

In the early days, industry was made up of individual enterprises and small shops. The owner worked side by side with his workers. He could keep track of his work almost by memory. He rarely kept records, because of his proximity to the business. As the shop grew into the small factory, and the factory into the corporation, it was no longer possible for the owner or the manager to know all the members of his organization. This brought the need of organizing the men into groups for unified, concerted effort. In these early days, the administration of industrial establishments depended principally upon the personality of the owner or manager, and empirical methods were used. What the manager thought or believed was the working principle of the organization and its activities. As industry and enterprises grew, it became necessary to substitute scientific methods for those based mainly upon executive opinion. The substitution of facts for the manager's "I believe" or "I think" was expedient.[1]

A company is made up of individuals each different from every other. This would require that employees should be organized and managed individually, yet there are sufficient similarities in a group of people to facilitate a general plan of organization. Therefore, it is essential that the type and method of organization apply to as many of these similarities as possible, yet provide ample opportunity for handling individual differences. With reference to this Henry Dennison[2] has said:

---

[1] Ibid.

[2] Henry Dennison, Organization Engineering (New York: McGraw-Hill Book Company, 1931), pp. 4-6.

> The ultimate in organization would require that the incentives, regulations, and personal contacts of each member should be such as to allow him to develop and put to most valuable use all of his powers. Since no two members are exactly alike there would be, theoretically, separate provisions for each. But all members, though different, are compounded of quite similar elements; their differences are in large part differences in the proportions in which these elements are represented. Hence, some reasonably uniform general measure can usually be devised to appeal to, to satisfy, and to control the more widely prevalent elements of human nature. An important practical task of the organization engineer lies in so grouping the personnel and devising the general rules that the largest possible number are effectively provided for; at the same time, he must be ready to deal with individual cases wherever the unsuitability of general rules causes losses which outweigh their gains in convenience and cost of administration.
>
> The structural form of an organization affects and alters the spirit which works through it. The spirit alters and re-creates the structure. The running of an organization and the building of it depend upon each other--affect and are affected by each other.
>
> The importance of right structure or organization is sometimes undervalued, because with the right men almost any kind of organization can run well. This is true, but is by no means the whole truth. With the finest of personnel, an illogical organization structure makes waste through internal friction and lost motion; it fails to retain and develop good men and to invite into its membership new men of high quality. Ability, tact, and good purpose cannot be established by law--they can, however, by law be made possible or virtually impossible. With an able man in charge, cities have been run well under the crudest form of political structure; but crude forms of political structure rarely make it possible to get a really capable man to run and be elected to office. The same is true in a corporation. A logical, well-constructed organization invites, retains, and develops good men.

Time and Motion Study.--Time and motion study has been defined in a number of ways. Frederick W. Taylor, the father of scientific management, was the first to devise time study in the Midvale Steel Company in 1881. Taylor's later definition and explanation were as follows:

> Time study is the one element in scientific management beyond all others making possible the "transfer of skill

from management to men," ... "Time study" consists of two broad divisions, first, analytical work of time study, and second, constructive work of time study.

The analytical work of time study is as follows:

a. Divide the work of a man performing a job into simple elementary movements.
b. Pick out all useless movements and discard them.
c. Study, one after another, just how each of several skilled workmen make each elementary movement, and with the aid of a stop watch select the quickest and best method of making each elementary movement known in the trade.
d. Describe, record, and index each elementary movement, with its proper time, so that it can be quickly found.
e. Study and record the percentage which must be added to the actual working time of a good workman to cover unavoidable delays, interruptions, minor accidents, etc.
f. Study and record the percentage which must be added to cover the newness of a good workman to a job, the first few times that he does it.
g. Study and record the percentage of time that must be allowed for rest, and the intervals at which the rest must be taken, in order to offset physical fatigue.

The constructive work of time study is as follows:

h. Add together into various groups such combinations of elementary movements as are frequently used in the same sequence in the trade, and record and index these groups so that they can be readily found.
i. From these several records, it is comparatively easy to select the proper series of motions which should be used by a workman in making any particular article, and by summing the times of these movements, and adding proper percentage allowances, to find the proper time for doing almost any class of work.
j. The analysis of a piece of work into its elements almost always reveals the fact that many of the conditions surrounding and accompanying the work are defective; for instance, that improper tools are used, that the machines used in connection with it need perfecting, and that the sanitary conditions are bad, etc. And knowledge so obtained leads frequently to constructive work of a high order, to the standardization of tools and conditions, to the invention of superior methods.[1]

---

[1]Subcommittee on Administration of the A.S.M.E. "The Present State of the Art of Industrial Management." Trans. of the American Society of Mechanical Engineers, Vol. 34, pp.119-120.

Motion study, or micromotion study, was first developed by Frank B. and Lillian B. Gilbreth. They defined motion study as follows:[1]

> Motion study consists of dividing work into the most fundamental elements possible; studying these elements separately are in relation to one another; and from these studies elements, when timed, building methods of least waste.

A definition to include both time and motion study is given by Professor R. M. Barnes of the University of Iowa as follows:[2]

> Time study is the analysis of the methods, materials, tools, and equipment used, or to be used, in the performance of a piece of work; the development of the most economical way of doing this work; the standardization of these methods, materials, tools, and equipment; and the accurate determination of the time required by an average man to do it.

The purpose of time study during the earlier years of its existence was commonly conceived to be the setting of wage rates or the determination of a standard time to do work upon which rate setting could be based. In later years, it has acquired a new conception--stating, analyzing and solving work problems, as well as a technique of measurement.[3]

Today the aims or purposes of time and motion study have come to be as follows:

1. Measurement of work for rate setting.

---

[1]Frank B. and Lillian M. Gilbreth, Applied Motion Study (New York: Sturgis and Walton Company, 1917), p. 43.

[2]R. M. Barnes, Motion Study (Iowa City, Iowa: University of Iowa, 1933), p. 1.

[3]Lillian M. Gilbreth, "Motion Study," Handbook of Business Administration (New York: McGraw-Hill Book Company, 1931), p. 628.

2. Reduction of the effort or energy in performing work, and decrease of the fatigue involved.
3. Discovery of the most efficient method, or the one best way, of doing work.
4. Reduction of the cost of production, or the increase of production.
5. Increase of the workers' wages.
6. Teaching of correct motions and methods to the workers, and the training of foremen and workers to be motion-minded.
7. Improvement of skill, interest, and enjoyment in doing work.
8. Improvement of the quality of the product.
9. Production of products at the right time.
10. Solving of work problems.[1]

---

[1]Walters, op. cit., pp. 67-68.

CHAPTER IV

MONEY[1]

Today the management of money is one of the principle factors in the success of scientific management as a whole because money must be available with which to employ men, to purchase materials, to manufacture, to market the product and to make a profit. The management of money involves ownership, financing, profits, and the other financial affairs of the company. First, money is made available through ownership--somebody must own the business. This ownership is defined by the financial structure. As materials are used, as men work, and as the product is marketed, profits must be realized--the prime mover of economic activities and the mark of success of modern management.

Ownership.--In general, money matters involve getting money or getting rid of it--borrowing or lending it. One person has the money and wants to put it to use, while another has not the money and wants some to use; the money problem is to get the two together. One of the important uses of money to the man who has it is to buy something and become the owner. Similarly, in industry and business a person or group of persons who have money

---

[1]The author is indebted to Dr. K. K. Das, Professor of Business Administration, Atlanta University, Atlanta, Georgia, for much of the material in this chapter, given in lectures to the latter's Money and Banking class.

may become owners by putting money into the business. The common forms of ownership are: the individual proprietorship, the partnership, and the corporation.

The Individual Proprietorship. The individual proprietorship was the original form of private enterprise. The individual owner is the sole manager of all the factors that affect his particular business. He hires whom he pleases, buys what he pleases, and conducts his business in whatever way he wants to. He is responsible to himself personally for profits and losses, and is legally liable for all his acts and possessions. When he dies his affairs as an individual proprietor cease, a situation which may prevent long-time loans to the individual.

The Partnership. In the partnership two or more individuals pool their assets in manufacturing a product or performing some service. They may put in different amounts of money. One may put in money and another service. One may contribute capital, one experience, and another services or prestige, with an agreement as to the division of profits. Each partner is an agent for the business and can make contracts binding each and all of the partners. Any act of any one partner binds the others. Each partner is liable for the debts of the firm even to the extent of his private property. If one partner purchases anything for the firm, all the partners are liable for the obligation contracted. In some partnerships the partners divide the profits and losses equally, and in some states limited partnerships exist under the law whereby the liability of the partners may be limited. Under a general partnership all partners must assume the responsibility for the integrity and services of the other

partners. That is why professional firms such as lawyers and doctors are partnerships. When a person patronizes a firm of lawyers and doctors he is buying the reputation of the firm or the individuals of the firm, who must perform their services with such high integrity that they will hold the confidence of their clients. Each partner trusts the others. If such partners do not trust each other, they could hardly expect clients to trust them.

The Corporation. In many business proprietorships and partnerships, there grew a desire and need to shift responsibility from the shoulders of individual persons to the firm. This led to the organization of the corporation. A corporation is an intangible being existing only in contemplation of law. It loses the element of personal responsibility and is a separate entity, doing only those things which the law permits and which the state, in a charter or articles of incorporation, authorizes it to do. The corporation is virtually a contract with the state. The principals of a corporation are responsible for the acts of its agents, but the agents are not responsible for the acts of the principals. The corporation, being an artificial person, is not the stockholders because they own it, yet the corporation owns the corporate property. Because its life is not contingent upon the life of the stockholders, the corporation is permanent and exists throughout the life of its charter.

The corporation has only those powers expressed and implied in the charter. The stockholders vote in person or by proxy, but the directors vote only in person. The stocks of corporations are classed as voting and non-voting, the latter having ownership

but no vote in the management.

Besides the distinctions mentioned, there can be public corporations and public service corporations, moneyed corporations--such as banks and insurance companies--holding companies, and private corporations which are the ordinary business corporations.[1]

Financing.[2]--The methods of obtaining money for the purpose of financing a company may be classified generally into (1) ownership and (2) liens. Each of these has its many ramifications, which may be outlined in general as follows:

1. Ownership: Stock-shares (equity)
   - Preferred — As to: dividends {Cumulative; Non-cumulative}; assets....1st, 2nd, 3rd preferred
   - Common
     - A.....Voting; and management
     - B.....Non-voting, unless dividends are not paid; investment

2. Liens: Bonds or notes (borrowed money)
   - Mortgage or trust agreement
   - Bond or note

   — Senior liens (1st mortgage); Junior bonds (2nd mortgage, etc.)

One means of obtaining money is through ownership--the sale of certificates of stock which represent a share of the

---

[1]For a description of these, see C. W. Gerstenberg, Financial Organization and Management of Business (New York: Prentice-Hall, 1932).

[2]The writer is indebted to Dr. Harding B. Young, Dean of the School of Business Administration, Atlanta University, Atlanta, Georgia, for many of the ideas presented in this section.

aggregate ownership of a corporation. Each type of stock is divided into identical units called shares, which are represented by certificates of stock. The stock is the ownership, and the shares are units of ownership evidenced by the certificates which are issued to the purchasers. Groups of stock are usually classified as preferred and common. The preferred stock usually carries with it a preference over the common as to dividends and assets. As to dividends, the preferred may be cumulative, which means that if dividends are not paid they accumulate from year to year, or non-cumulative, in which case a dividend which is passed by the corporation is lost to the stockholder.

Common stock usually carries with it a voting privilege, and, therefore, the right to control and manage the affairs of the corporation. However, the common stock may be divided into classes A, B, etc., where class A stock is usually the voting stock, and only those holding the class A stock can control the financial affairs of the company and elect the officers who manage its operations. The common stockholders elect the directors. The directors elect the officers. The class B stock is usually non-voting (except when dividends are paid). The class B stock is usually an investment stock and shares in any extra profits enjoyed by the corporation. A stated dividend on the class B stock may be paid before the dividends on class A are paid.

The financing of a company may also be handled by borrowing money--liens. These liens may be in the form of bonds or notes. A manager may borrow money from a bank, giving his note

for the money which is secured by property or other collateral. If the loan is for a long period, bonds are usually issued with one or more mortgages on the property of the borrower as security. A bond is the written acknowledgement of the debt. It is generally made to the bearer, usually with interest coupons attached which are redeemed upon presentation to a bank and then forwarded for collection to the fiscal agent of the company.

The interest on bonds is a fixed expense--the larger the bond issue the larger the fixed expense. High bonded indebtedness should usually be avoided unless profits are practically certain to be greater than the interest on the bonds. If the profits are not so great as the interest on the bonds, difficulty will ensue--with possibilities of foreclosure or financial loss. This emphasizes the fact that in any financing or purchasing of stocks or bonds the balance sheet and the profit and loss statement should be closely scrutinized. As general rules, the current assets and current liabilities should be equal, and the fixed assets should be two, three, or four times the fixed liabilities. A wise manager of money will be cautious, consider his investments thoroughly and carefully, and make the offerer of the stocks or bonds prove all his statements.[1]

Profits.--Industrial management is tested primarily by its earnings. Profits--that portion of the income over the expenditures or of selling price above costs--usually indicates management's efficiency. They are the motivating force of our

---

[1]From Finance class lecture notes. Lectures were given by Dr. Harding B. Young, November 18-22, 1963.

economic and industrial activity.

Profits depend upon many factors. One company may stress one factor and make its profits principally by that factor, whereas another may stress another factor and secure profits by it. Good management will consider and use as many as possible of the following factors on which profits are based: (1) service; (2) management and administrative efficiency; (3) efficient production methods, and high reward or incentive for skill, knowledge, and excellent effort; (4) strong financial structure; (5) patents; (6) efficient marketing, including superior advertising and efficient sales management; (7) control of raw materials, or excellent purchasing; (8) consolidation and monopoly; (9) quality of product; (10) research and experimentation; (11) price.

The more of these factors employed the greater should be the profits and their security. The value of each of these factors may vary in different companies. For example, the Ford Motor Company may have the most efficient production methods, while the American Telephone and Telegraph Company and the Standard Oil Company may secure their profits largely through monopoly and consolidation, and General Foods and Coca-Cola largely because of price. Mr. Knoeppel emphasizes[1] the service objective of business as an important method of making profits.

Dr. H. G. Moulton[2] has emphasized the fact that lower prices will expand the volume of sales without necessarily reducing

---

[1]C. E. Knoeppel, Profit Engineering (New York: McGraw-Hill Book Company, 1935).

[2]H. G. Moulton, Income and Economic Progress (Washington, D. C.: The Brookings Institution, 1935).

the profits, and, indeed, will protect profits by the reduction of unit costs, which offsets the low prices.

Other methods of managing profits are by means of budgets,[1] profit and loss statements, balance sheets, and financial statements.[2]

---

[1]For a discussion of budgets, and a further treatment of profits, see the section on "Profits and Budgets" in Chapter XI.

[2]For samples and discussions of profit and loss statements, balance sheets, and financial statements, see Alexander Wall, How to Evaluate Financial Statements (New York: Harper and Brothers, 1936).

CHAPTER V

MEN

Scientific management of men involves the application of the scientific method to human problems. It collects facts and uses them for the purpose of preventing personnel difficulties from arising. It is preventive in nature. Preparatory to hiring, facts are obtained about applicants to prevent the hiring of a man unsuited for the work. Physical examinations and health procedures are maintained to prevent later physical difficulties on the part of the worker and the spreading of disease to the other workers. Safety activities attempt to prevent accidents. Employee representation gives employees an outlet for grievances and complaints before a break between employer and employee occurs and difficulties ensue.

Personnel Management.--Personnel management is the application of the scientific method to the human problems of obtaining an efficient force adapted to the organization for which it is intended. Its objectives are maintaining mutually harmonious and profitable relations between employer and employee, and of making adequate provisions for care for the personnel after their service to the organization over the period of greatest usefulness. The personnel activities and procedures in particular companies, carried by individual managers, will naturally vary

according to the special nature and needs of the different companies.[1]

The principal divisions of personnel management in a well managed company are summarized as follows:[2]

1. Office of the Manager of Industrial Relations.
   a. Includes the general administration of all personnel activities and of the Employers' Suggestion System and Employees' Representation Plan.
2. Employment Division.
   a. Recruiting and preliminary selection of employees.
   b. Furnishing staff assistance to the Salary and Wage Administration Committees.
   c. Maintaining employees' records.
   d. Compiling statistical and other reports.
3. Employees Service Division.
   a. Administration of the various employee thrift, benefit, and insurance plans.
   b. Cooperation with the various employee social and recreational organizations.
4. Dean of Women's Office.
   a. Employment of women.
   b. Other problems relating to women employees.
   c. Lunchroom.
      (1) Preparing and serving daily luncheons and special dinners to employees at cost.
   d. Library.
      (1) Maintaining a suitable collection of reference books and magazines and providing a library service for the departments of the company.
5. Medical Division.
   a. Physical inspection.
   b. Visiting nurse service.
   c. Surgical and first aid service.
   d. Health promotion.
6. Training Division.
   a. Functional supervision over supervisory jobs, and public-contract training.
   b. Conducting company-wide training programs, such as management training.
   c. Handling reimbursements for employees who have

---

[1]Paul Pigors and Charles A. Myers, Personnel Administration (New York: McGraw-Hill Book Company, 1961), pp. 132-133.

[2]Walters, op. cit., p. 131.

satisfactorily completed educational courses in outside educational institutions.

7. Safety Division.
   a. Functional supervision over safety work in the company.

The personnel management of the U. S. Gypsum Company[1] has the following divisions:

1. Obtaining quality personnel--employment.
2. Instilling a knowledge of the business--training.
3. Placing the man properly in the company--organization.
4. Maintaining adequate working conditions--working comditions.
5. Measuring performance with U.S.G. standards--production.
6. Paying for results--compensation.
7. Outside activities and relationships--welfare.

The high extent to which the companies carry on many of these personnel activities, and the facts that some of these activities were maintained at an increasing rate during the last depression, and that the personnel field in general has not decreased as much as general employment and pay rolls, indicate that employers have not lost sight of the value of handling adequately the human problems in industry. If the maintenance of such activities continues to increase, we can expect the future human problems in industry to be handled more adequately and thereby we can expect that industry will become an increasingly human and vital force in social advancement.[2]

Employment.--The effective selection of employees is one of the most important phases of the scientific management of men. If an efficient employee is hired, his management is easier than

---

[1] Ibid., pp. 131-133.

[2] Ibid., p. 141.

that of an inefficient one. If an inefficient employee is hired, even good management may not be able to manage well. In general, effective selection will result from the application of scientific methods to employment problems. As in the other phases of management of men, the application of scientific methods to selection applies more to group (personnel) efficiency than to individual efficiency. For example, the use of a good clerical test to employ clerks may not be effective with a particular applicant, but it may prove excellent in securing a higher percentage of efficient clerks from a group of 100 than if the test were not used. In other works, personnel activities should be looked upon as an aid in predicting group performance. With the use of the test the manager may select 75 efficient employees out of 100, whereas without the test he may select only 50. In this case he would be increasing the efficiency of his selection 25 per cent by the use of the test. The clerical test is used only as an example, but the same principle will apply to other employment and personnel activities.

The employment procedure generally involves the following:

1. The development of a source of personnel supply.
2. Interviewing.
3. Tests and examinations.
4. Selection.
5. Introduction to the job.

All five of these steps in the employment procedure are essential, but space will only be provided to discuss interviewing.

Interviewing. "When I am confronted with a complex situation involving the interactions of people, what people say is

necessarily an important part of the data from which I have to make a diagnosis. Therefore, my first object is to get people to talk freely and frankly about matters which are important to them.... In the interview I use a number of simple rules or ideas. I listen, I do not interrupt. I refrain from making moral judgements about the opinions expressed. I do not express my own opinions, beliefs, or sentiments. I avoid argument at all costs. I do this by seeing to it that the speaker's sentiments do not react on my own."[1]

Proficiency in interviewing can be learned. It is an art, not an exact science, and always involves the play of individuality and initiative. Fundamentally, the purposes of the interview are to find out facts, to inform the interviewee, and to motivate him. In the employment interview all three purposes should be realized. The interviewer should find out facts about the applicant, and he should inform the applicant sufficiently about the work being offered and the company to motivate the interviewee in or out of the company. In interviewing, the following instructional principles[2] have been found effective:

1. Know as many as possible objective criteria and subjective viewpoints about the interviewee in advance of the interview.
2. Prepare a schedule and list of questions for the interview, or have available job specifications of the work to be done. It is important and valuable to have a definite program for the interview.
3. Make appointments in advance wherever possible, for time is saved in seeing the interviewee promptly and

---

[1]Words of F. J. Roethlisberger, Management and Morale Cambridge, Mass.: Harvard University Press, 1941), pp. 92-93.

[2]Adapted from W. V. Bingham and B. V. Moore, How to Interview (New York: Harper and Brothers, 1931).

in shortening preliminary explanations.

4. Provide privacy for every interview.

5. Take the interviewee's point of view. Try to put yourself in the applicant's place; without that, there may be a misunderstanding.

6. Examine and discount your own prejudices. Are your ideas warped on any subject which you must discuss with the applicant? If so, try to keep the applicant from knowing them.

7. Gain and deserve the interviewee's confidence by showing evidence of genuine confidence and interest in him.

8. Help the interviewee feel at ease and ready to talk. First, be at ease yourself and make it apparent. Begin with pleasant topics. Try to find mutual likes and interests.

9. Do not ask questions directly until you think the interviewee is ready to give the desired information and to give it accurately. Listening by the interviewer is very important. Let the interviewee tell his story. Then help him to supplement it.

10. Keep on the subject of the interview. When necessary ask a question or make a suggestion which will lead back to the general subject of the interview.

11. Be straightforward and frank rather than shrewd and clever. Do not try to deceive or trick the interviewee by your questions.

12. Avoid impertinence. Help the applicant realize his responsibility. Record all data from the interview at once, or at the earliest opportunity.

13. Allow sufficient time for the interview if possible. Do not rush it through. Get all the facts, yet keep control of the interview. Keep the interviewee aware of the definite purpose which should be attained in the limited time.

Employer-Employee Dealings.--After a man is permanently employed, certain problems and difficulties usually arise in which he and his employer are mutually interested. As they are mutually interested, the best relationship which should exist between them is that of mutual cooperation and definite consideration of each by the other. Under the old type of management, the management gave orders and the employee obeyed them or quit. Today, after years of experience in joint relationships, scientific management has come to know that greater efficiency can be obtained by dealing cooperatively with employees and providing for opportunities of

discussion and consideration with employees such matters of mutual interest, as hours of labor, wage rates, working conditions, safety and accident prevention, promotion of health, and employee welfare. Scientific management has become quasi judicial in nature. In recent years, the National Industrial Recovery Act and the Wagner National Labor Relations Act granted employees the legal right to self-organization, to bargain collectively through representatives of their own choosing, and to engage in concerted activities for the purpose of collective bargaining in matters of financial aid and mutual protection without any interference, coercion, or restraint from employers. Though the National Industrial Recovery Act has been declared unconstitutional by the Supreme Court, the Wagner Labor Relations Act has brough forcibly to the attention of employers the necessity of providing some plan of collective consideration of matters of mutual interest to employer-employee.

In general, there are three methods of employer-employee dealings: (1) the individual basis, (2) employee representation, and (3) collective bargaining through a trade or labor union.[1]

---

[1]Walters, op. cit., p. 151

CHAPTER VI

MATERIALS

The scientific management of materials has probably received more attention in the past than the scientific management of men. At present the direction of human relationships seems to be increasing, though there still is and always will be emphasis on the problems of selection, control, and disposition of materials. For example, in 1935 the General Motors Corporation spent $15,000,000 on the improvement of their plants, especially materials, machinery, maintenance, and their management.

Losses which result from the poor management of materials can be discerned and determined more quickly than human waste. For most companies the cost of materials is greater than that of labor, and as such the management of materials often assumes the greater portion of the executive's time.

Before any materials can be used and maintained, they must be purchased. When purchased they must be handled. The following two sections will be devoted to purchasing and handling of materials.

Purchasing.--Because purchasing has always been a highly personalized procedure, the application of the scientific method has been slower than in some of the other fields of management. Purchasing was greatly diversified and difficult to systematize because each purchaser knew what he wanted to purchase. Earlier,

products were not as complicated and did not require the exactness of present-day purchasing practice. Scientific purchasing is each buying based upon facts. In particular concerns, scientific purchasing has reduced the purchase price on special items as much as 50 per cent. The objectives of scientific purchasing may be stated as follows:

1. Decrease in purchasing price.
2. Procurement of materials which best suit the product and the purposes for which they are intended.
3. Use of scrap and defective products.
4. Reductions of inventories to the lowest and best balanced use.
5. Improvement of the product with reference to quality and merchandising by means of selection of adequate material.

Purchasing is the procurement of the proper materials and supplies used in the manufacture of a product, adapted to marketing, in the proper quantity and quality at the proper time and at the lowest price consistent with the quality desired.

Effective purchasing may be carried out by the following steps:[1]

1. The ascertainment of an accurate statement of character and amount of material or commodity needed, preferably based upon exact specifications.
2. The development of the desirable sources of supply and the negotiation with those sources by means of requests for bids.
3. Analysis of the proposals, the selection of the vendor, and the placing of the order.
4. Follow-up of the order, routing the order, checking invoices, and the inspection of goods.
5. The maintenance of controlled inventories.
6. Completion of the records.

Though the purchaser uses these steps, he must determine

---

[1] Compiled from the National Association of Purchasing Agents, Purchasing: An Outline of Essentials and Methods (New York: 1930), Chapter III.

whether he should buy direct or through the middleman. If small quantities are to be purchased the middleman may furnish the best source of supply. The consideration of from whom the materials shall be purchased must be studied with reference to the amount, quality, and other factors of the purchase. The final decision in all these matters of purchasing rests upon the goal of the right price which includes a consideration of quality and the other purchasing factors.

Materials Handling.--Upon purchase, materials arrive at the factory from the railway car or truck, are transferred to the storeroom or directly to the job, are then moved from job to job until they are finished, and are placed in stock or shipped to the customer. The handling of materials through this moving process represents a large cost--a greater part of the non-productive costs. These high handling costs are generally indicated where:[1]

1. Unnecessary handling is performed.
2. More than one man is moving materials without mechanical assistance.
3. Men are lifting and handling articles weighing more than 100 pounds.
4. Men are loading from floor to trucks or from trucks to floor.
5. Machine operators are doing any laborious lifting or any work except putting articles into machine, supervising machinery operations, and removing articles when finished.
6. Materials are moved from container to container.
7. Materials are unnecessarily diverted from receiving platform for clerical records or inspection when they should go directly to machines.
8. Men on assembly floors or elsewhere are waiting for materials.
9. There are delays in delivering from storeroom to operators.

---

[1] L. P. Alford (Editor), Cost and Production Handbook (New York: Ronald Press Company, 1934), p. 852.

10. Scheduling for delivery is inadequate, causing delays at machines or necessitating extra delivery trips.
11. There is retrograde movement of materials in process of fabrication.
12. Antiquated apparatus or methods are in use.

The reduction of these costs may be made by the application of certain principles which have been discovered. The first principle in handling materials is not to handle them, or to handle or move them the least possible amount. With the introduction of conveyors in recent years, some companies have been able to manufacture their products "on the move," that is, while the materials are being moved from place to place, or from job to job. Another principle is to make the materials-handling routine as automatic as possible, and in a direct line without regression and with as few transfers and delays as possible.

W. T. Spivey has given the following nine rules that apply to materials handling:[1]

1. Know every kind of materials equipment on the market.
2. Analyze materials routing carefully.
3. Visualize each job's actual needs.
4. Buy for operating savings, not for first cost.
5. Get together with designers and manufacturers.
6. Lay out equipment when building is planned.
7. Rearrange equipment systematically.
8. Teach operator possibilities in his equipment.
9. Maintain equipment the same as production machinery.

Roe and Lytle[2] have given some general principles and methods of materials handling as follows:

1. Reduce all transportation to the lowest possible limits; therefore:
2. Reduce lines of travel, and wherever possible have the machines and operations in sequence. To do this:

---

[1]Alford, op. cit., p. 853.

[2]J. W. Roe and C. W. Lytle, Factory Equipment (Scranton, Pennsylvania: International Textbook Company, 1935), p. 467.

3. Lay out a flow sheet of the various operations and route of materials.
4. Avoid crossing streams of traffic and possible congestion.
5. Utilize gravity wherever possible.
6. Eliminate or reduce the human labor in the movement of materials.
7. Avoid changing materials from one container to another or loading from the floor to trucks, and vice versa.
8. Coordinate the movement with production, to avoid waits for materials, or the piling up of materials at various points.
9. Make the handling equipment perform process work, if possible, during transportation, as, for instance, stirring or drying in a screw conveyor.
10. Provide flexibility, if possible, so that a breakdown of one piece of handling equipment will not shut down the plant.

In moving or handling materials, a first essential is to be familiar with all types of equipment. A good classification of materials-handling equipment has been made by S. J. Koshlin.[1]

The results accomplished by the proper materials handling are increases in production, decreasing in handling costs, and, in general, savings in handling materials. The Nash Motor Company saved $8,600 per year by installing standard conveyors for handling automobile cylinder blocks. The American Radiator Company saved $22,000 per year by installing standard conveyor systems for handling their iron and steel. The Belden Manufacturing Company made a yearly profit of $12,450 on an investment of $19,611 from the installation of a complete conveyor system for handling their metal-working materials. Many other savings[2] can be found which show that proper materials handling pays.

---

[1]For a complete classification of materials-handling equipment see S. J. Koshlin, Modern Materials Handling (New York: John Wiley and Sons, 1932), pp. 7-9.

[2]Alford, op. cit., p. 886.

CHAPTER VII

MACHINERY

The importance of machinery in the scientific management of an up-to-date manufacturing establishment today can be realized by the $15,000,000 modernization program which the Buick Motor Company carried out to obtain their 1936 business. They purchased 380 new machines and relocated, surplused, or scrapped 5,968 old machines.[1] The objectives of their modernization program were: (1) to reduce costs, (2) to reduce repairs and maintenance costs, (3) to provide for adequate capacity by producing a greater volume on the same floor space, (4) to make necessary engineering changes by the replacement of obsolete equipment and to have precise control of operations, (5) to improve quality, and (6) to improve the working conditions. These objectives were attained through the following channels: (1) purchase of new equipment to cut costs and improve quality, (2) rebuilding and retooling of existing machines, (3) rearrangement of existing machines and conveyors, (4) reduction of the number of machines, (5) smoother flow of materials and parts in process, (6) reduction of waste, (7) increase in volume (as related to cost), (8) simplification of product

---

[1] Factory Management and Maintenance, "Buick's Fifteen Million Dollar Bid," Vol. 93, No. 12, December, 1935, p. 499. Also, "Where Buick's Fifteen Million Dollars Went," Vol. 94, No. 1, January, 1936, p. 5; Vol. 94, No. 2, February, 1936, p. 61.

(reduction from 26 to 14 models).

Though a particular company may not have the immediate need for moderization of its machinery, every modern manager must have a knowledge of up-to-date machinery if he is to improve the quality of his product, increase production, reduce costs, and intelligently replace worn-out and obsolete machinery when the situation demands it. He must have a general knowledge of the kinds of machinery, the kinds and amounts required for his company.

The prime considerations in the selection of machinery are: the investment which is justified in the installation of the new machine, the savings that will accrue from its purchase, the years in which the new machinery will pay for itself, and whether the unit cost of production is cheaper with the new or proposed method than with the present method.

Evolution in Machinery.--The machinery of the ancients was developed mainly for warfare or for the performance of miracles. Some of the early Hellenistic inventions for practical purposes were those of Hero of Alexandria who, according to Giedion,[1] "built and improved oil presses, fire fighting pumps; invented lamps with automatically advancing wicks, or water tube boilers for heating bath.... The Alexandrian inventors were masters in combining the so-called 'simple machines,' such as the screw, the wedge, the wheel and axle, the lever, the pulley, powered by combinations of water, vacuum or air pressure, to carry out complicated movement or manipulations. Thus, the temple gates swung open automatically

---

[1]Siegfried Giedion, Mechanization Takes Command (New York: Oxford University Press, 1948), pp. 31-34.

as soon as fire was kindled on the altar and swung to when the flame died."

Hero mounted wheels on figures to be rolled on wooden rails for use in religious plays, but no practical application of this principle came into use for transportation purposes until the 17th century, when wooden rails were used in English mines. The ancients' outlook on life was such that they gave little attention to the practical application of their inventions. It was not until the 18th century that inventive genius was directed into utilitarian channels.[1]

Machinery of Today.--Compared with the machinery construction of today, the machinery described in the preceding section was neither large, complex, nor efficient. The machinery of today has become larger and more complex, faster in operation, more automatic, capable of saving more time and labor, capable of handling bigger products more accurately, and better suited to the purposes intended. They can be produced at lower costs and maintained with less expenditures in material and labor than machines produced in the preceding decade. Improvements are continuous. Labeling machinery that once applied 60 labels per minute to bottles, then 120 per minute, now can apply 300 per minute and the manufacturers are already working to find ways to raise this capacity to 500 labels per minute. At the same time, they are producing machinery that will wear longer, look better, do a better and more economical job of labeling.

---

[1] Ibid.

The developments in machinery since the 18th century are indicated to some extent by the increases in patents issued by the United States Patent Office. According to a report by the New York State Joint Legislative Committee on Industrial and Labor Conditions,[1] each decade from 1941 to 1940 has shown a larger number of inventions than the period before. In the two decades from 1941 to 1960, there has been slight decreases in inventions. These decreases are due to the effects of World War II and the Korean Conflict.

Today, the new science of "Cybernetics"[2] is in full blossom. The machinery of tomorrow will incorporate the principles of this science into their design and construction.

---

[1]New York State Joint Legislative Committee on Industrial and Labor Conditions, The American Story of Industrial and Labor Relations, Legislative Document #2, 1953, p. 71.

[2]For a definition and a full description of the science of "Cybernetics," see, N. Wiener, Cybernetics (New York: John Wiley and Sons, Inc., 1959).

CHAPTER VIII

MAINTENANCE

Maintenance is the upkeep, repair, renewal, and replacement of worn, damaged, or obsolete parts of buildings, machinery, and equipment. The objective of maintenance is to keep the plant in operating condition, and to arrest depreciation and forestall obsolescence.

Maintenance may be preventive or corrective in character. Preventive maintenance implies frequent inspection to detect minor faults and the early correction of them, supplemented by periodic overhauling in accordance with a plan so that the possibility of a major breakdown is almost entirely eliminated. Corrective maintenance implies that action is taken only when the need for it becomes obvious, and, therefore, gives no assurance that a major breakdown will not occur.[1]

Most plants use both types of maintenance. Where a major defect in one of the buildings, or in a vital machine, would seriously reduce or completely stop production, a preventive maintenance program is indicated. Machines or equipment that are not so vital to production often receive attention only when they must be repaired. The trend is toward increased use of preventive maintenance

---

[1]H. Russell Beatty, Principles of Industrial Management (New York: The Ronald Press Company, 1951), p. 619.

in order to minimize interruption in operation and keep equipment in condition for the most efficient performance.

Functions of Maintenance.--The functions of maintenance, both preventive and corrective, include and should be organized to:

1. Making emergency repairs.
2. Inspecting buildings and fixed equipment at such intervals as will insure detection of deterioration and the need for repairs.
3. Inspecting machinery and equipment at such intervals as will insure detection or misadjustment, wear, or impending breakdown.
4. Making such repairs, renewals, or replacements as inspection shows to be necessary.
5. Keeping systematic records of inspections and repairs.
6. Keeping tickler records to warn of the necessity for reinspections.
7. Suggesting and assisting in developing changes and improvements in the design of machinery and equipment to decrease the liability of breakdown, reduce the necessity for frequent adjustments or repairs, and lengthen the service life.
8. Putting in effect changes and improvements developed under point 7, above.
9. Operating such service activities as may be assigned to the maintenance department.[1]

The functions of the maintenance department are limited by company policy, and differ among industrial plants. As an illustration: some concerns turn over the design of power plant equipment to their maintenance engineers; others have the work of design and the supervision of installation of such equipment done by outside consulting engineers.

Organization of Maintenance.--The organization of maintenance varies widely in industrial concerns, being dependent upon the scope of the functions to be performed and the size of the

---

[1] Ibid., pp. 620-621.

plant to be served. In representative organizations the work is divided into three groups of activities: (1) building, (2) mechanical, and (3) electrical.

In large plants, the maintenance is often organized according to the five divisions of: (1) power generation, (2) engineering, (3) building, machinery, and equipment construction and maintenance, (4) maintenance job control and clerical functions, and (5) housekeeping and other services. To the power generation division are allocated the duties associated with providing power, heat, light, and other utilities necessary for the operation of the plant. To the engineering division is allocated the design of changes and improvements in machinery and equipment, and other work of a design or engineering nature. To the building, machinery, and equipment construction and maintenance division is assigned the execution of the work prepared by the engineering division, or designated by the maintenance inspectors or production executives. The maintenance inspectors make routine, current, and emergency inspection of buildings, machinery, and equipment and report the need for repairs, replacements, and improvements. The job control group is responsible for timekeeping, follow-up, budgeting, costing, and record-keeping. To the housekeeping division is assigned the responsibility for plant protection, janitor service, care of grounds, cafeteria operation, and other services of this kind.[1]

Supervision of Maintenance.--Maintenance must be closely supervised if the returns are to justify the money spent. Much

---

[1] Ibid.

effort has been expended in an attempt to establish proper work methods and performance standards for maintenance work, but only the very large organizations which employ large numbers of people in each of the crafts have been successful with these techniques. The importance of good maintenance supervision is usually underestimated, for the men often work on their own, and this frequently leads to the erroneous impression that they do not need direction. Actually, the planning, scheduling, and assigning of maintenance work and the control of performance require high-grade supervision to assure good results at low cost. Measures used for the over-all effectiveness of maintenance supervision sometimes are: (1) mortality studies, (2) "outage" studies or studies of the losses in production output due to machine down-time, and (3) comparisons of the relative size of maintenance forces in various plants.[1]

In recent years there have developed certain methods of maintenance, such as the regular periodic inspection and checking of the different phases of maintenance. Elevator gates are checked daily; scales, weekly; pumps, monthly; electric lamps, semiannually; and power equipment, annually, are such examples. With these standard inspections on the basis of approved standards for actually making the inspections, and with adequate records of inspections, maintenance cost may be so controlled as to bear the least ratio to production costs. Assistance to that end may be obtained by budget and time allowances for main-

---

[1]L. P. Alford and J. R. Bangs, Production Handbook (New York: The Ronald Press Company, 1944), p. 1260.

tenance work. Some companies set standards on the time allowed for performing maintenance service and offer incentives for better than the standard achievement. By such methods as these, maintenance is organized at the least cost.[1]

The efficient and safe plant is the one that is orderly and clean. One of the principles of scientific management is that good maintenance pays off in better quality, lower costs, and more satisfied workers. To attain the desired results, responsibility for good maintenance should be definitely fixed, and supervision provided through periodic inspections.[2] Over-all responsibility for maintenance is often assigned to the plant engineer even though part of the work must be done by the operating force and others. Probably the most difficult part of the job is to secure and maintain the proper attitude toward the program on the part of each and every employee. Good maintenance committees, made up of representatives from the various groups in the plant, have been effective in improving attitudes and in securing the desired results.

---

[1]Walters, op. cit., p. 246.

[2]An excellent check list for maintaining an orderly plant is given in Alford and Bangs, op. cit., pp. 1317-1321.

CHAPTER IX

MANUFACTURING

The scientific management of manufacturing involves the control of production from the raw material to the finished stock by the best and cheapest method, so that the product will be of the best quality and delivered at the required time. It is the determination of what shall be produced, and how, when, where, and why it shall be produced. It is production that adds value to the material manufactured, and is the wealth-producing process of industry.

The scientific control of manufacturing or production endeavors to prevent difficulties by setting and maintaining standards of production. It is based on recorded data and facts rather than empirical personal opinion.

Whatever the type of manufacturing process, or the size of the company, production control usually involves issuance of orders, planning, scheduling, dispatching, and inspection.

Issuance of Orders.--The authorization to commence production is given by means of a manufacturing or production order. The forms of these orders vary greatly in character. Such orders may be actual or virtual. In custom work, they are always the former. Each production order deals with a specific order, as received from the customer. In mass production and in continuous

industries, production orders may be virtual, that is, simply an understanding that a certain output is to be maintained over a coming period. Even in the latter case, some device must be adopted to distinguish the production of one period from that of another. Monthly outputs are frequently used in this way. Instead of charging cost to a specific order number, they are charged to a specific month's production.[1]

The objectives aimed at by the issue of manufacturing or production orders are: (1) to convey information as to customer and promised time of delivery, (2) to serve as a nucleus for the collection of cost data, for the order as a whole, for the individual components, and for the operations performed on the components, and (3) to form a starting point for the control system.[2]

Planning.--Planning is the thinking process, the organized foresight, the vision vased on fact and experience that is required for intelligent action. The steps in planning have been described in the definition given by George B. Galloway:[3]

> Planning is the opposite of improvising. In simple terms, it is organized foresight plus corrective hindsight... Conceived as a process, planning embraces a series of steps:
>
> 1. The determination of objectives to be sought.
> 2. Research to understand the problem.
> 3. The discovery of alternative solutions.
> 4. Policy making--choosing between alternatives, including the frequent choice of doing nothing.
> 5. The detailed execution of the chosen alternative known in physical planning as layout or design.

---

[1]Walters, op. cit., pp. 252-253.

[2]Beatty, op. cit., p. 400.

[3]George B. Galloway, Planning for America (New York: Henry Holt and Company, Inc., 1941), pp. 5-6.

The work technique used in planning has been described by Edward H. Hempel as "fact finding, analysis, concluding and coordination of facts and actions toward a best and practical conclusion and goal."[1] A quotation from Abraham Lincoln will assist us in understanding the work technique in planning: "If we could first know where we are and from whither we are tending, we could better judge what to do and how to do it."[2]

Scheduling.--Scheduling is the determination of when the work is to be performed on each part of each assembly of each model of each product. This is accomplished by means of a master schedule, a part schedule, and an operation schedule. The master schedule is a composite schedule of the work of the whole plant; it is broken down into its different departments, with a schedule of each job and each operation so that each part will be finished at the proper time for final assembly.

After the production schedule has been made it is necessary to control production according to that schedule. A greatly used tool of management for controlling production is the Gantt chart,[3] which was first developed by Henry L. Gantt, the prominent industrial and management engineer. The Gantt chart has been adapted not only to the fields of production control but also to sales and various other types of business and industrial activities

---

[1]Edward H. Hempel, Top Management Planning (New York: Harper and Brothers, 1945), p. 7.

[2]Quoted from Chester I. Barnard, Organization and Management (Cambridge: Harvard University Press, 1948), p. 134.

[3]For a description of the Gantt chart, see H. L. Gantt, Organization for Work (New York: Harcourt, Brace & Howe, 1919).

where a comparison of the work accomplished and the work which should have been done is desirable.

Some companies have devised what is called a control board for maintaining and visualizing their master schedule. This control board contains a number of horizontal rows, one for each machine or job with the space after each machine or job divided into columns of days or periods of work. Below each the exact work that should be performed on that machine at that particular time is posted after each machine. The visual check is maintained to show what was actually performed and to show delays, idleness times, and losses.

After the schedule has been made and the control board set up it is necessary to follow through and dispatch the work as scheduled.

Dispatching.--Dispatching is the routine of setting productive activities in motion through the release of orders and instructions, in accordance with previously planned times and sequences, embodied in schedule charts. In well-organized production departments, dispatching tends to become a mechanical routine, particularly if the production planning has been complete and accurate. Dispatching is concerned with starting the processes and operations of production.

The principal factors or activities included in dispatching are:

1. Movement of material from stores to the first process, and from process to process.
2. Issue of tool orders instructing the tool department to collect and make ready tools, jigs, and fixtures in advance of the time at which the operation will commence.

3. Issue of job orders authorizing operations, in accordance with dates and times previously planned and entered on the machine loading charts, route sheets, and progress control sheets or boards.
4. Issue of time tickets, drawings, insturction cards, and other necessary information to the personnel performing the work.
5. Issue of inspection orders after each operation to determine the result in number of pieces "good" and "bad" and the causes of spoilage.
6. Issue of move orders and collection of time tickets, drawings, and instruction cards for all completed operations.
7. Recording time of beginning and completing job, and calculating duration; forwarding completed records to production department and time card to payroll department.
8. Recording and reporting idle time of machines and operators.[1]

Though the manufacturing may be planned, scheduled, and dispatched adequately, there must be a check upon the quality of the product. Scientific management requires inspection of products so that they will be of the desired quality.

Inspection.--Inspection is the art of applying tests, preferably by the aid of measuring appliances, to observe whether a given item or product is within the specified limits of variability. Inspection suggest, essentially, a judicial function: a comparison of the product, as it is, with the product defined by the specifications. This comparison may require nothing more than a visual examination for cracks, scratches, off-color finish, etc. On the other hand, it may require extremely accurate measurements as with optical instruments, X-ray examination for internal flaws, and other highly technical means for assuring that the product is in accordance with that specified by the engineers. The trend is toward more accuracy in component parts manufacturing

---

[1]Beatty, op. cit., p. 413.

so that the performance of the finished product will be better, without sacrificing interchangeability or increasing the time required in the assembly operations. The means of making measurements are constantly being improved to provide for faster and more accurate comparison of products with more rigid specifications. To accomplish these results, electronic, optical, and pneumatic measuring devices are replacing the micrometer and caliper for many mass-production operations.

The objectives of inspection are:

1. To detect errors in manufacturing and trends toward poor quality and report them to responsible officials in the producing departments so that action may be taken to prevent making units of product that are not acceptable, or a level of quality of product that is below that specified.

2. To protect the consumer from receiving a product that is below the quality level and limits specified, by sorting the good units or lots from those which are below standard, permitting only the good to pass inspection.

3. To compile information regarding the conformance of the product with specifications for the use of engineering, production, purchasing, quality control, and other divisions responsible for quality performance.[1]

---

[1] Ibid., pp. 451-453.

CHAPTER X

MARKETING

Marketing is the term applied to the processes of distributing goods from the producer to the ultimate user. It consists of advertising and selling; storing, transportation, and handling; and financing or risk-taking. Marketing is generally classified as consumer or industrial, depending upon the nature of the ultimate use.

Consumer marketing consists of the distribution processes by which producers distribute consumption goods such as foods, clothing, household furnishings, and the like to individuals for their personal use. It includes merchandising or the selling of consumer goods to the ultimate users. The buying of such goods may be, and often is, motivated by emotional appeals. Consumer marketing usually involves distribution of identical goods in large quantities and is, therefore, associated with mass production.

Industrial marketing consists of the distribution processes by which producers distribute machinery, equipment, goods, and services to industrial buyers. The buying of such products and services is motivated by economic considerations and not by emotional appeals. The manufacturers of raw materials or component parts to be sold to manufacturers of consumer goods are

frequently continous process producers, but the machinery, equipment, and services manufacturers are generally jobbing or intermittent type producers. The techniques used in the distribution of consumer goods differ from those used in the distribution of industrial goods.[1]

The subject of marketing can be approached from several standpoints--that of the product, the agency doing the marketing, and the functions involved in marketing. The scientific manager may have to consider all these approaches, but because marketing is a function of management we will consider it from the functional standpoint. The functions of marketing may be considered as: the market analysis, or consumer research; and advertising, publicity and public relations.

Market Analysis.--With the large gap between the producer and the final consumer, the scientific manager finds in difficult to know the consumer's needs, tastes, and desires with reference to his product. Likewise he may not know what the consumer's knowledge of his particular product and service is. The market analysis endeavors to provide this information for the manager.[2]

The purpose of the market analysis is to determine the location, volume, and buying habits of the individuals or groups that make up the potential market for a product. The market for consumer goods is the individuals who have the economic means and

---

[1] Ibid., pp. 259-260.

[2] See H. G. Weaver, "Consumer Research and Consumer Education," Annuals of the American Academy of Political and Social Science, November, 1955.

the potential need or desire for a product. The volume of the market is determined by finding out how many individuals there are at locations which can be reached economically via the channels of distribution to be used. The buying habits of these people are studied to determine the most economic techniques to use in influencing them to buy. There are regional tastes and prejudices which influence the sales of many consumer goods, and these must be discovered in order to avoid losses.

From market studies, the number of potential buyers may be estimated and the volume of business to be done in the future predicted. These estimates are frequently made by analyzing the potential in a limited area, from which an index may be developed for guidance to business possibilities, i.e., number of establishments, number of employees, value of the product, value added to the product, horsepower utilized, tons of material used, percentage of oblolete to modern equipment, and the like. This information, combined with a study of business and economic trends and close observation of sales performance in the various parts of the country or world, is the basis for making "guesstimates" of probable sales volume.

Another important aspect of market analysis is a study of the buying habits of the potential customers to determine the character of the market. This information is necessary in planning an effective sales program. The following indicate some of the important factors in this phase of the marketing problem:

Who buys the product being offered?
How many other individuals influence the purchase?
Where are the buyers located?
How much time (on the average) will be required in selling them?

What do buyers emphasize--price, quality, delivery service, safety?
When are potential customers in the habit of buying?
How much do they buy at one time?
How often do they buy?
Do they buy ahead of need?
Is it a seasonal market?
What discount and credit terms are customary?

Advertising, Publicity, and Public Relations.--After analysis of the market and along with the actual selling goes the advertising of the products. Advertising in recent years has become practically a profession in itself. It has been studied scientifically from the psychological and other viewpoints.

In light of direct research with the readers of advertising, J. G. Jenkins[1] has given the following as the psychological aims of an advertisement:

> I. The primary aim of advertising is always to influence human action. Since the copy theme or advertising message has been found to be the chief means of influencing action, this must be brought to its most effective level. This will involve a search for a specific copy theme in a particular market at a particular time.
>
> II. The accessory aims of advertising include all steps necessary to make the total advertisement an effective governor of action. Since it is not necessary to obtain maximal effectiveness, general rules from other researchers will be adequate to guide the handling of these accessory features. Typical accessory features include those items designed to:
>
> 1. Secure and hold the attention of the reader.
> 2. Make a clear and coherent impression.
> 3. Make an impression which will last for a time.

The scientific manager has the job of having advertising material prepared to accomplish those aims with a specific copy theme

---

[1] J. G. Jenkins, Psychology in Business and Industry (New York: John Wiley and Sons, 1935), p. 259.

or advertising message for the particular commodity, market, and time.[1] This emphasizes then that generalized advertising is greatly out of date, and that strict specificity in advertising the product concerned is in order.

Although these aims may apply to all media of advertising in newspapers and journals, television, radio, general publicity, specific publicity, handbills, posters, etc., the media actually employed will, of course, depend upon the product, the company, and the marketing methods, the type producing the most sales being used the most. The test of the type to employ and, in fact, of all advertising is the measured results in increased sales or replies from the advertisements.

Besides the direct advertising, much can be obtained along this line from general publicity of the company and its product.

For example, in 1936, there appeared many articles on aluminum and its manufacture, celebrating the fiftieth anniversary of the discovery of aluminum. This not only gave interesting facts about aluminum, but indirectly advertised the product.

Some companies ask their officers and sales forces to make speeches about their companies and products, realizing that it is good advertising and publicity for the companies and products.

A number of companies, in recent years, have established public relations departments to promote satisfactory relations between the company, its employees, and the public in general. This has been especially true of the public service companies. Also, some industrial concerns have found it necessary to protect

---

[1] Ibid., p. 257.

their interests from extreme criticism and governmental regulations by promoting their interests in communities and in governmental bodies. With the possible trend toward the more strict regulations of industry and business as exemplified by the National Recovery Act, the National Labor Relations Bill, and various New Deal legislation after 1933, the scientific manager may find it necessary to participate more and more in community, public, and governmental affairs in order to promote the interest of his company and protect himself from too strict regulations of his management.[1]

---

[1]From lecture notes dated March 23, 1964 in Advertising class. Lecture given by Mrs. Johnnie M. Clark, Assistant Professor of Business Administration, Atlanta University, Atlanta, Georgia.

CHAPTER XI

MEASUREMENT

In recent years management has had to measure its performance by the actual results shown. Without some proof of measure of its performance management has not completed its job. Some of the methods of measuring management are: (1) research, (2) profits and budgets, and (3) social service.

Research.--Research is important to the management from two standpoints: from that of measuring the results of management; and from that of general industrial research for the purpose of finding new products, improving quality, reducing costs, using by-products, and developing new fields of application.

One of the important methods of finding what management has accomplished is through research, which is the application of the scientific method to the results accomplished by management. This would mean the collection of the facts about those results, the classification of those facts, and the maintenance of those methods and results which the facts prove are the best for management. From the standpoint of new management methods, a similar procedure of approach can be used. That is, the collection of facts about the new method, the classification of the facts about the new method with reference to the advantages and disadvantages of it in comparison with the old, and the selection

or rejection of the new method based upon the facts obtained. Therefore, management should apply the scientific method to its old as well as its new methods. While management research is concerned principally with the management methods, the whole subject of industrial research is vital to the advancement of industry in general or any company in particular.

Industrial research has a broader aspect than purely management research, because it can be pure research on some fundamental industrial or technical problem, practical research on new products or problems, or the development of old products into new forms or new uses.

The National Research Council found the following emphases in the industrial research programs in 1956:

1. New Products--38 per cent.
2. Improved quality--37 per cent.
3. Reduction in production costs--19 per cent.
4. The development of new fields of application--5 per cent.
5. By-products--1 per cent.

If the management wishes to carry on research it has the problem of developing some type of organization, finding someone in the company to do it, or having some agency or person outside perform the research function for it. If the management wishes to do the research within the company, it may establish a research laboratory. The Dupont Company, The Bell Telephone Laboratories of the American Telephone and Telegraph Company, and General Motors Corporation have such laboratories. In these and similar companies a centralized research department carries on most of the research work of the company.

In some companies the research is decentralized in each

functional department--production, sales, or by-products--such as tire research and tube research in the rubber companies. Under the decentralized plan, the research pertaining to the separate department is done in that department's laboratory.

In other companies the research is accomplished in an informal way, the person interested in the research carrying it on as a side line to his regular managerial or other work.

If a company is not large enough or cannot afford to carry on its own research, a number of possibilities for having its research done are available. Among them are the following:

1. The research laboratories in the universities.
2. Reference Bureaus, such as the "Inquiry Reference Service" of the U. S. Department of Commerce in Washington, D. C.
3. The governmental research laboratories, such as the Bureau of Census, Bureau of Standards, Bureau of Labor Statistics, etc.
4. The private consulting research laboratories, such as A. C. Nielsen Company, Chicago; Daniel Starch and Staff, New York; Dun and Bradstreet, Inc.; and R. L. Polk Company.[1]

Profits and Budgets.--Probably one of the most-used measures of management is profits. If a manager pays dividends and makes profits he is usually considered successful. Profits have been the keystone of industrial existence. If one manager makes more money than his predecessor he is usually considered the better from the standpoint of management. Usually the higher profits represent better management, as discussed at the end of Chapter IV, "Money."[2]

---

[1]Charles J. Dirksen and Arthur Kroeger, Advertising Principles and Problems (Homewood, Illinois: Richard D. Irwin, Inc., 1960), pp. 331-333.

[2]See section on "Profits."

An excellent method of determining profits and measuring management performance in the company as a whole and in each department is by means of budgets. Recently when a new president took over the management of a large company manufacturing refrigerators, one of the first management devices which he installed was an adequate budget system. He placed each department on a budget to that he could measure how each department performed by comparing actual results to the budget.

Each year or each accounting period a budget is set for each department's expenses, and at the end of the period the management can see whether the department has gone over or under the budget set. The budget usually serves to measure the efficiency of the department form the standpoint of expenses, of course, the budget being adjusted up and down according to the work required of that department.

In recent years the budgets are being based upon standard costs. That is, what each part or production should cost as determined by computations from management specifications. These standard costs are then compared to the actual costs in order to show variances and determine the relative efficiency of the production or management, either generally, in the aggregate or in specific sectors of an enterprise.

In general, budgeting has become a widely used tool of management to control and measure business performance.

Social Service.--From the standpoint of the individual company, the measurement would naturally be the profits, budgets, employment, etc. From the standpoint of society it is measured

by the amount of service which it renders to society, and the social benefit resulting from that management's production of useful goods and services.

Mass production is now possible, and if industrial plants were operated at full capacity we could produce enough to raise considerably the present standard of living, working even fewer hours than at present. It may be possible to maintain a thirty-hour week and still increase production by the improvement of management's and other methods, and by means of the further use of science in industrial mass production. Along with mass production naturally comes mass management and the need for a better distribution of the products of improved methods and managements.

In past years a number of suggestions have been made for the mass administration of industry as a whole.

Professor Homan[1] has divided the plans roughly into two divisions, those proposals for control of money and credit, and those for the reorganization of industrial control.

Sir Arthur Slater[2] predicts the solution of the problems upon a degree of social mindedness among bankers and industrialists. Mr. Javits proposes planning through the organization of trade associations, the elimination of selling below cost, providing for unemployment benefits or guaranteeing employment, and possibly arranging production quotas.

---

[1]P. T. Homan, "Economic Planning: The Proposals and the Literature," Quarterly Journal of Economics, Vol. XLII, No. 1, November, 1942, pp. 102-122.

[2]References to Sir Arthur Slater and the other names mentioned here can be found in Professor Homan's article.

Mr. Person proposes the same technique of control which scientific management has developed in organizing and managing individual enterprises, for industry as a whole.

Professor Hobson presents the theory of over-saving and under-consumption as the primary cause of economic instability, and the removal of these for stability. Mr. Chase proposes collective control over industrial organizations, steeply graduated income taxation, control of investment, a managed currency, and a program of public works.

Mr. Beard would put all important industries on a public utility basis, with each industry organized into a syndicate controlled by a holding company, and each holding company controlled in turn by a national economic council.

Most of these plans doubt the adequacy of unregulated private enterprise, and concern themselves with some form of planning or "coordinated" control.

The author believes that the application of the scientific method to a planned industrial society would accomplish the best results. If one starts to plan society, one of the first difficulties is that he has not adequate facts upon which to base his decisions. Therefore, it seems fitting as least to start on the collection of social facts if we wish to devise some kind of a planned society. Many of the authorities upon social planning seem to agree that society should be so planned that everyone would have the necessities of life; others contend that we should improve the present standard of living and provide some of the semi-necessities of life or luxuries for each person. Practically

all will agree that no one should exist in poverty.[1]

The author believes that a higher standard of living and a higher social order can be maintained if a higher level of production is maintained, and that this can be done by more intelligent industrial management and the application of science and the scientific method to planning of individual industries, of industry as a whole, and to society.

---

[1]From a speech by President Lyndon B. Johnson given in Atlanta, Georgia on May 7, 1964.

CHAPTER XII

CONCLUSION

The Future of Scientific Management.--In each chapter of this thesis, much has been said that bears upon the question as to what is to be expected of scientific management in the future. It is a philosophy of high hopes, a system of magnificent prospects. It also has serious problems.

The unfriendliness of organized labor has been noted. The scientific management, strange to say, complain more of the opposition of employers. Besides being sceptical as to the merits of the system, those in authority generally hesitate to permit outsiders to reorganize their plants; the result is that the innovations introduced, whether by the regular management themselves, or in a sporadic way by efficiency specialists, are apt to fall far short of conforming to any regular type. Even in plants where scientific management has been installed by the most skilled experts, as soon as the leaders are out of sight there is a tendency to drift back into old habits. Hence, the growing insistence on having an "up-keep man," someone permanently connectly with the staff, who will supervise efficiency features. Many go so far as to urge that the consulting specialists be eliminated entirely. Each plant, it is maintained, must solve its own problems.

In view of these practical considerations, it would be very strange if the nine M's of scientific management that we have discussed is not in the future greatly transformed and differentiated. Indications are that scientific management is in use and will come into wider use; but to maintain that it, in precisely its present form, will one day dominate the industry of America or of the world, would be to make a hazardous prediction. Nevertheless, it is certain that industry is in a general way moving in the direction of complete scientific management.

Miss Edith Wyatt has said, very beautifully, at the close of her work, "Making Both Ends Meet":[1] "No finer dream was ever dreamed than that of industry by which the nation lives, should be so managed as to secure for the men and women engaged in it their real prosperity, their best use of their highest powers. How far scientific management will go toward realizing the magnificent dream in the future, will be determined by the greatness of spirit and the executive genius with which its principles are sustained by all the people interested in its inauguration, the employers, the workers, and the engineers."

---

[1]Edith Wyatt, Making Both Ends Meet (New York: The Macmillan Company, 1947), pp. 269-270.

BIBLIOGRAPHY

Books

Alford, L. P. Henry Laurence Gantt, Leader in Industry. New York: American Society of Mechanical Engineers. Harper and Brothers, Publishers, 1934.

_____. Management's Handbook. New York: The Ronald Press Company, 1924.

Alford, L. P., and Bangs, J. R. Production Handbook. New York: The Ronald Press Company, 1944.

Beatty, H. Russell. Principles of Industrial Management. New York: The Ronald Press Company, 1951.

Copley, Frank B. Frederick W. Taylor, The Father of Scientific Management. 2 vols. New York: Harper and Brothers, Publishers, 1923.

Davis, Ralph C. The Fundamentals of Top Management. New York: Harper and Brothers, Publishers, 1951.

Dirksen, Charles J., and Kroeger, Arthur. Advertising Principles and Problems. Homewood, Illinois: Richard D. Irwin, Inc., 1960.

Drury, Horace B. Scientific Management. New York: Longmans, Green and Company, 1922.

Gantt, Henry L. Organizing for Work. New York: Harcourt, Brace and Howe, 1919.

Gilbreth, Frank B. Motion Study. London: Constable and Company, 1911.

Gilbreth, Frank B., and Lillian M. Fatigue Study. New York: The Macmillan Company, 1919.

Gilbreth, Lillian M. The Psychology of Management. New York: The Macmillan Company, 1921.

Jenkins, J. G. Psychology in Business and Industry. New York: John Wiley and Sons, 1935.

Moulton, H. G. Income and Economic Progress. Washington, D. C.: The Brookings Institute, 1935.

Person, H. S. Scientific Management in American Industry. New York: Harper and Brothers, Publishers, 1929.

Pigors, Paul, and Myers, Charles A. Personnel Administration. McGraw-Hill Book Company, 1961.

Roe, J. W., and Lytle, C. W. Factory Equipment. Scranton, Pennsylvania: International Textbook Company, 1935.

Roethlisberger, F. J. Management and Morale. Cambridge, Massachusetts: Harvard University Press, 1941.

Taylor, Frederick W. The Principles of Scientific Management. New York: Harper and Brothers, Publishers, 1911.

Walters, J. E. Modern Management. New York: John Wiley and Sons, Inc., 1937.

Articles and Periodicals

American Management Association. Employee Representation Technique. New York: Production Executive Series, No. 49, 1956.

Factory Management and Maintenance. "Buick's Fifteen Million Dollar Bid." Vol. 93, No. 12, (December, 1935).

Gilbreth, Frank B., and Lillian M. "The Three Position Plan of Promotion," Annuals of the American Academy of Political and Social Science, (May, 1916).

Homan, P. T. "Economic Planning: The Proposals and the Literature," Quarterly Journal of Economics, vol. XLII, No. 1, (November, 1932).

Murray, C. H. "What Personnel Policies Are Included in A Comprehensive Industrial Relations Program," Personnel. New York: American Management Association, vol. 12, No. 2, 1935.

National Association of Purchasing Agents. Purchasing: An Outline of Essentials and Methods. New York, 1930.

Subcommittee on Administration of the American Society of Mechanical Engineers. "The Present State of the Art of Industrial Management," Transactions of the American Society of Mechanical Engineers, vol. 34, 1937.

Thompson, Sanford E. "Time-Study and Task Work," Journal of Economy, (May, 1913).